J-11.2.2 Vadose Zone Sr-90 Simulation Results

The release of Sr-90 in this simulation followed the same procedure as was used in the RI/BRA-case:

- 15900 Ci from CPP-31 release in the tank farm were represented using (a) the activity-release function shown in Figure J-11-13 (H) for the 5580 Ci released during the first 20 years, and placing this activity flux directly above the basalt interface of the base model (Appendix A, Section 5.1). The remaining 10320 Ci were placed vertically through the alluvium, scaled to the measured soil concentrations obtained during the 2004 (Appendix G and Table 5-32) sampling cycle. To simulate the transport of the activity remaining in the alluvium, an effective K_d of 13 mL/g was used (Figure J-11-13 (J)) for the alluvium sediments.
- transport of Sr-90 from sources other than CPP-31 originating in the alluvium, whose location is spanned by the submodel (Appendix A, Section 5.1), were simulated using the submodel. Because these source locations were outside the influence of the high ionic strength, acidic CPP-31 release, a K_d of 20 mL/g was used in the submodel alluvium.
- transport of Sr-90 from sources located outside of the submodel horizontal extent were also placed in the base model used to simulate the transport of the CPP-31 remaining in the alluvium. The effective K_d for the alluvium underlying these source locations was also set to the value used to simulate the transport of Sr-90 predicted to remain in the alluvium after 20 yrs (first bullet). The relative magnitude of these sources are small relative to the residual Sr-90 predicted to remain in the alluvium after 20 yrs. In this case, the K_d is slightly lower than that used to simulate the transport of Sr-90 from sources within the submodel boundary. However, this should not affect the peak aquifer concentrations by more than 10%.

Figures J-11-14 through J-11-17 give the distribution of the Sr-90 in the vadose zone through the year 2293. Figure J-11-18 illustrates Sr-90 arrival in key perched water wells, and the match to field data for all perched water wells is summarized in Figure J-11-19. There are no significant differences relative to the RI/BRA base case.

Peak vadose zone concentrations through time are given in Figure J-11-20 and are shown in red. Highest concentrations (3.0E9 pCi/L) in the vadose zone are predicted to occur in 1978 and are a combination of the initial fast release of activity from CPP-31 and the activity from CPP-79. The peak concentration in the vadose zone assuming an infiltration rate of 39 cm/yr is about 1.5 times that obtained in the RI/BRA base case (black) with 22 cm/yr (18 cm/yr precipitation + 4 cm/yr anthropogenic water) infiltration. Higher vadose zone concentrations occur in the pore water of the alluvium and are associated with the increased activity remaining in the alluvium.

The rate at which Sr-90 enters the aquifer is given in Figure J-11-21 in red, and can be compared directly to the RI/BRA base case (shown as black). Fluxes from the vadose zone into the aquifer are slightly higher than predicted in the base case. The higher fluxes are primarily associated with increased migration out of the deep vadose zone. This is apparent because the increase in infiltration rate has resulted in:

- half as much Sr-90 leaving the alluvium in the first 20 years (5580 vs. 12336)
- three times as much Sr-90 remaining in the alluvium (10320 Ci vs. 3564 Ci)
- a significant decrease in mobility of Sr-90 out of the alluvium due to an increase in K_d (13 mL/g vs. 2 mL/g)
- increased dillution in the vadose zone caused by the higher infiltration rate

In the upper vadose zone, this should translate into lower concentrations. However, in the deeper vadose zone it results in more rapid migration of the Sr-90 introduced into the vadose zone from the failed injection well.

Figure J-11-14. Sr-90 vadose zone concentration with higher 39 cm/yr infiltration through the tank farm (horizontal contours) (pCi/L) (MCL = thick red line, 10*MCL = thin red line, MCL/10 = black line).

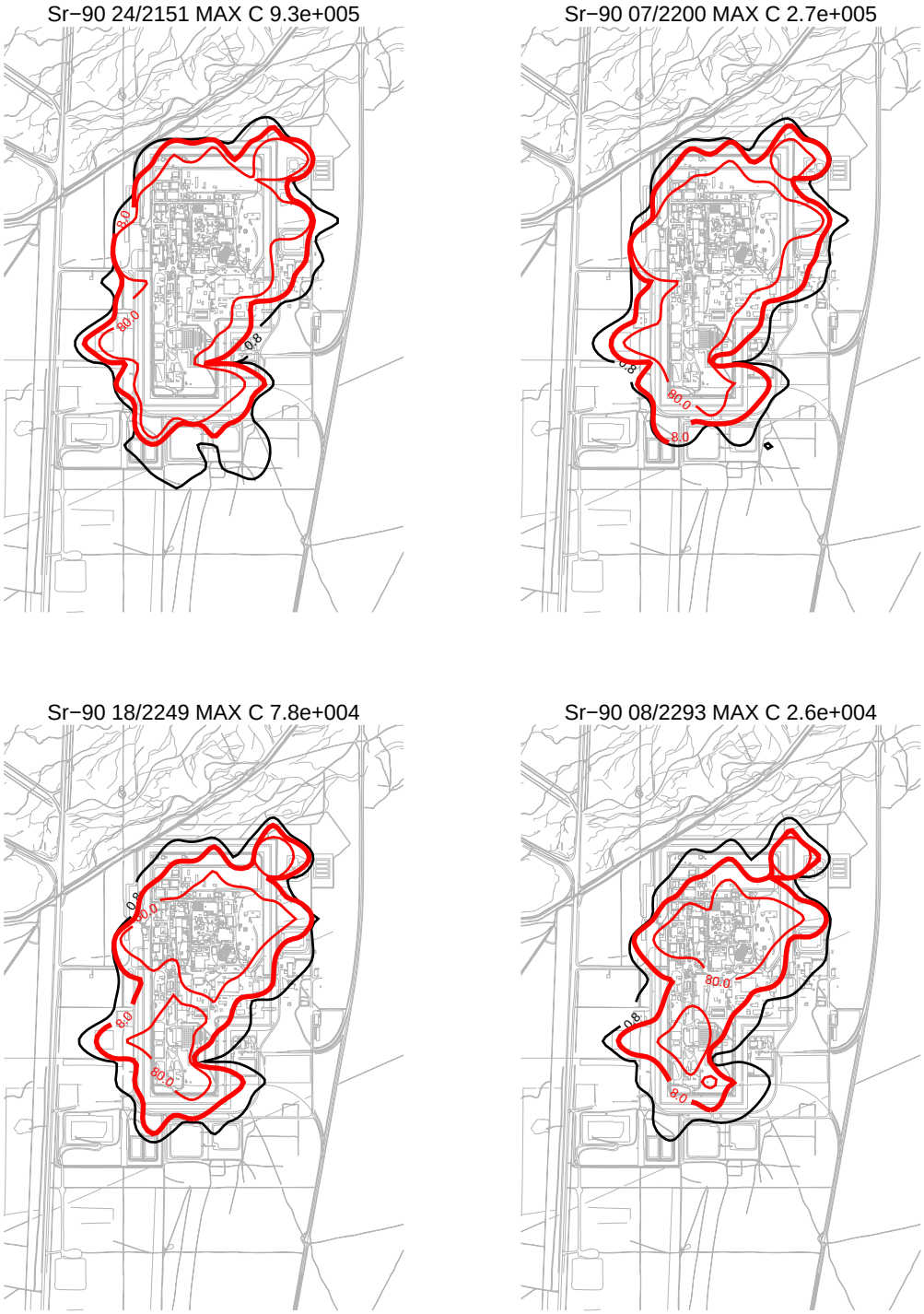

Figure J-11-15. Sr-90 vadose zone concentration with higher 39 cm/yr infiltration through the tank farm (horizontal contours) (pCi/L) (MCL = thick red line, 10*MCL = thin red line, MCL/10 = black line).

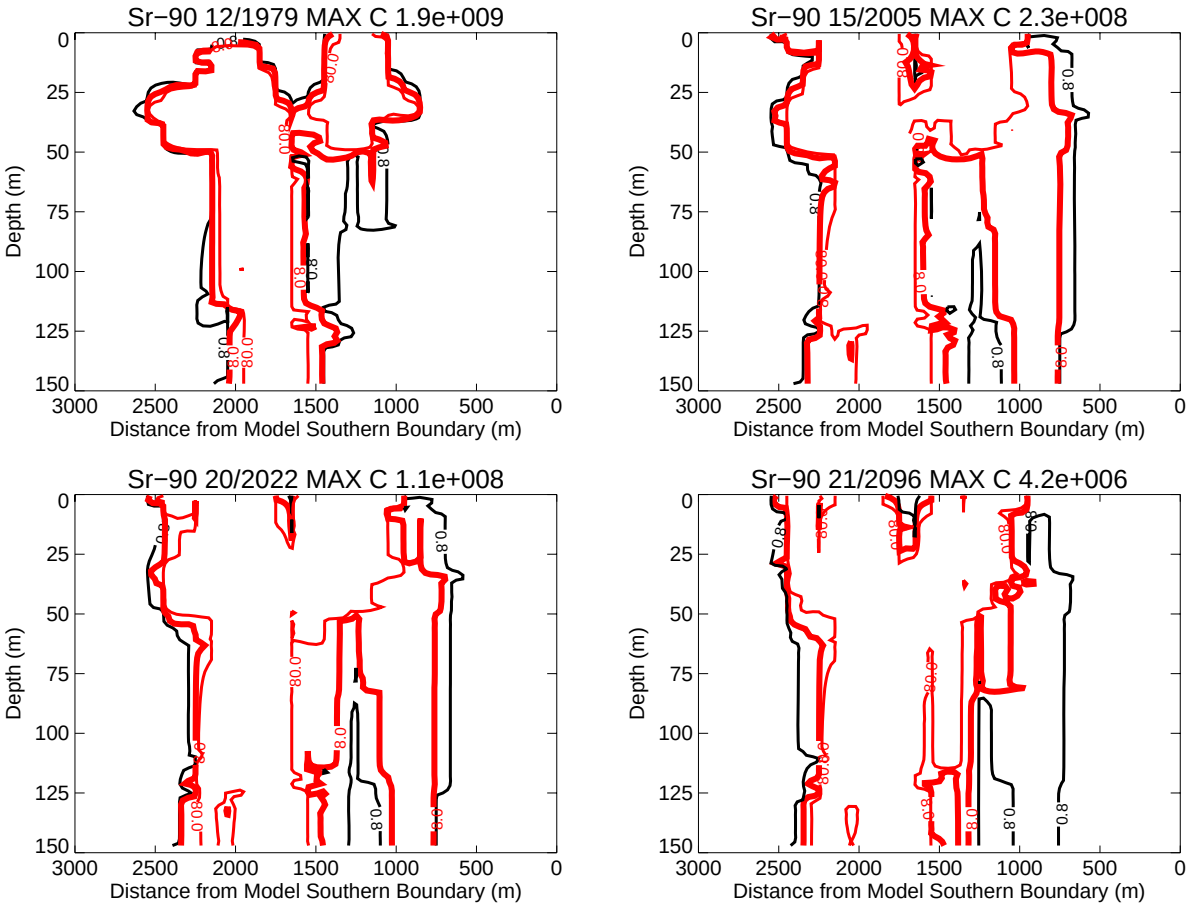

Figure J-11-16. Sr-90 vadose zone concentrations with higher 39 cm/yr infiltration through the tank farm (vertical contours) (pCi/L) (MCL = thick red line, 10*MCL = thin red line, MCL/10 = black line).

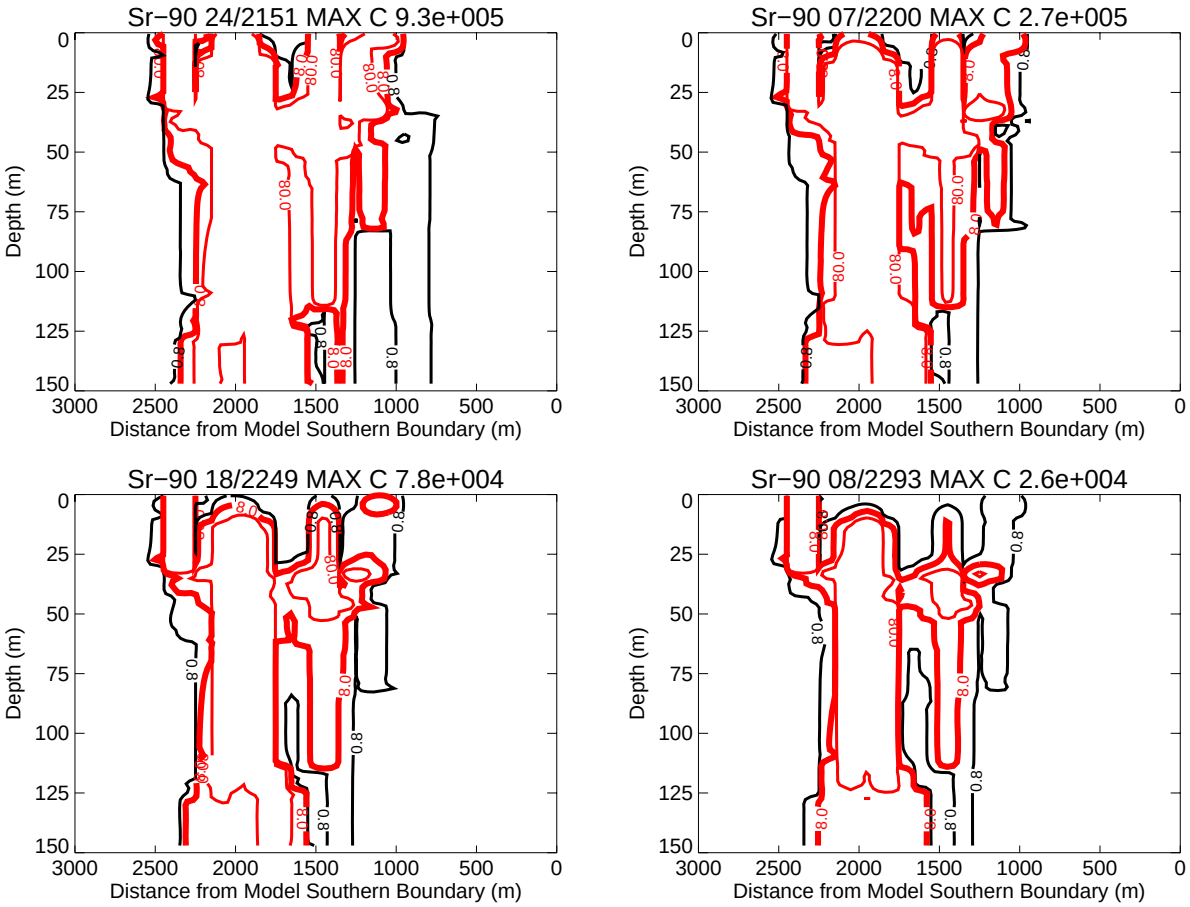

Figure J-11-17. Sr-90 vadose zone concentrations with higher 39 cm/yr infiltration through the tank farm (vertical contours) (pCi/L) (continued) (MCL = thick red line, 10*MCL = thin red line, MCL/10 = black line).

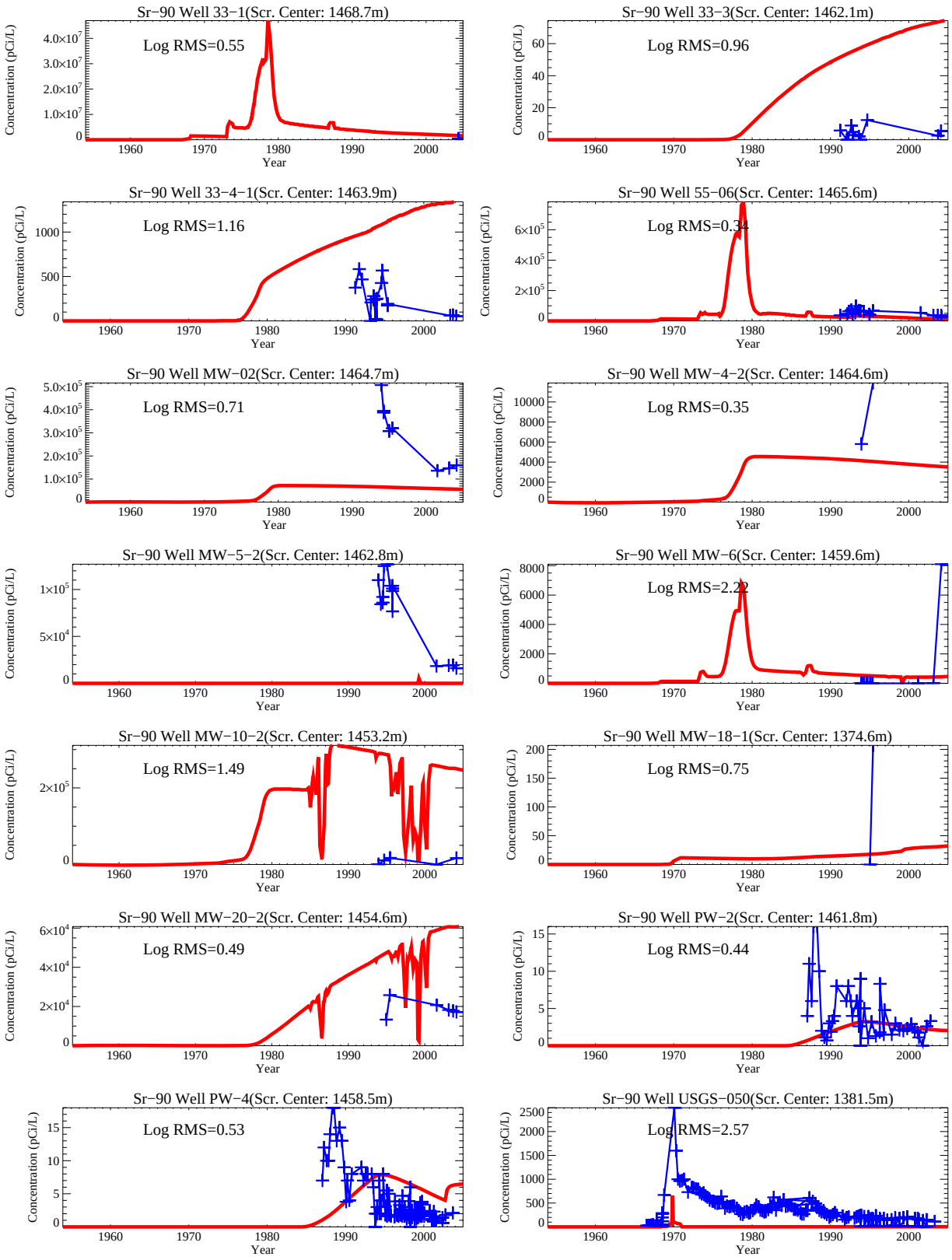

Figure J-11-18. Sr-90 concentration in perched water wells with higher 39 cm/yr infiltration through the tank farm(pCi/L) (Measured values = blue crosses, red = model at screen center).

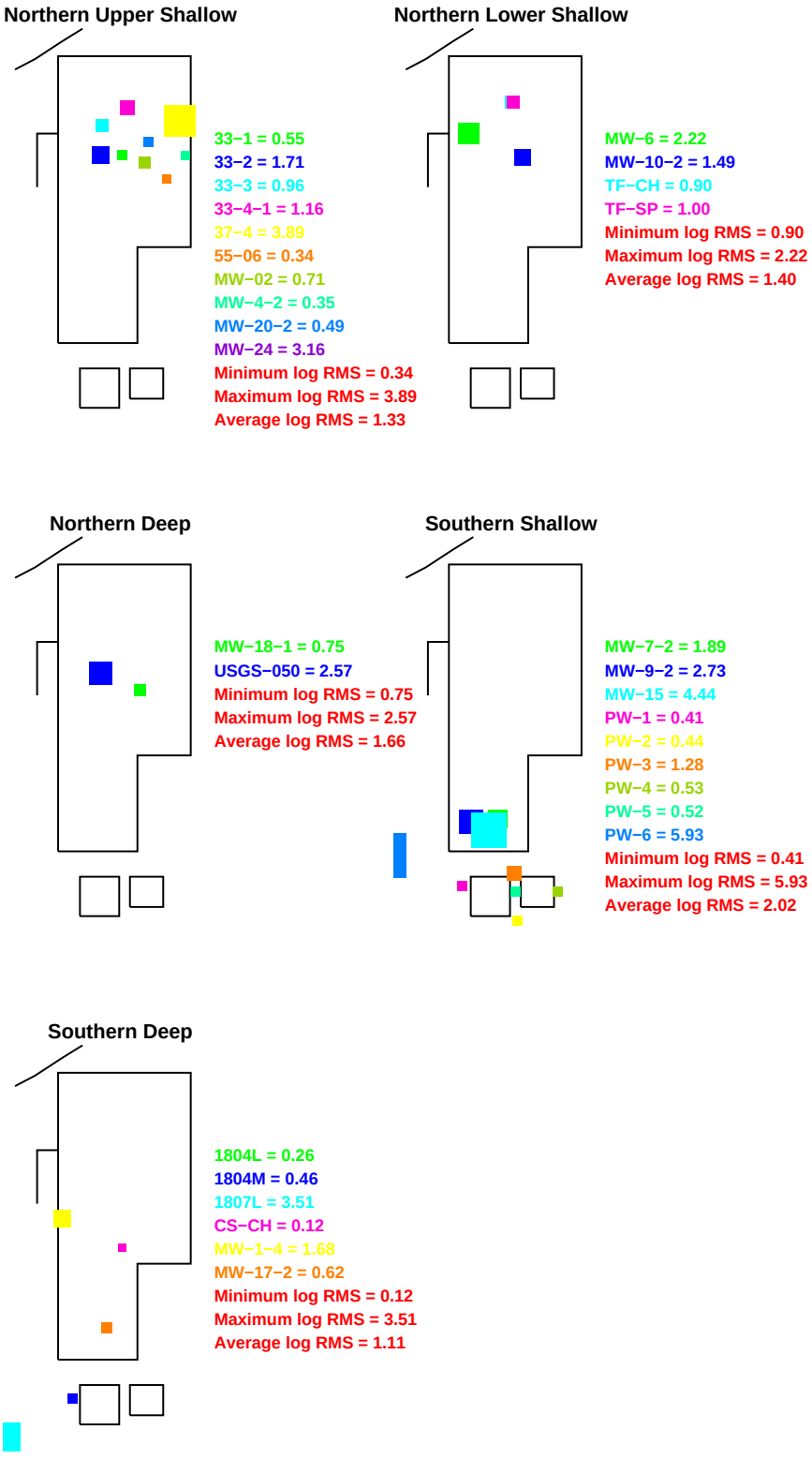

Figure J-11-19. Log 10 Root mean square error (RMS) by depth and northing with higher 39 cm/yr infiltration through the tank farm.

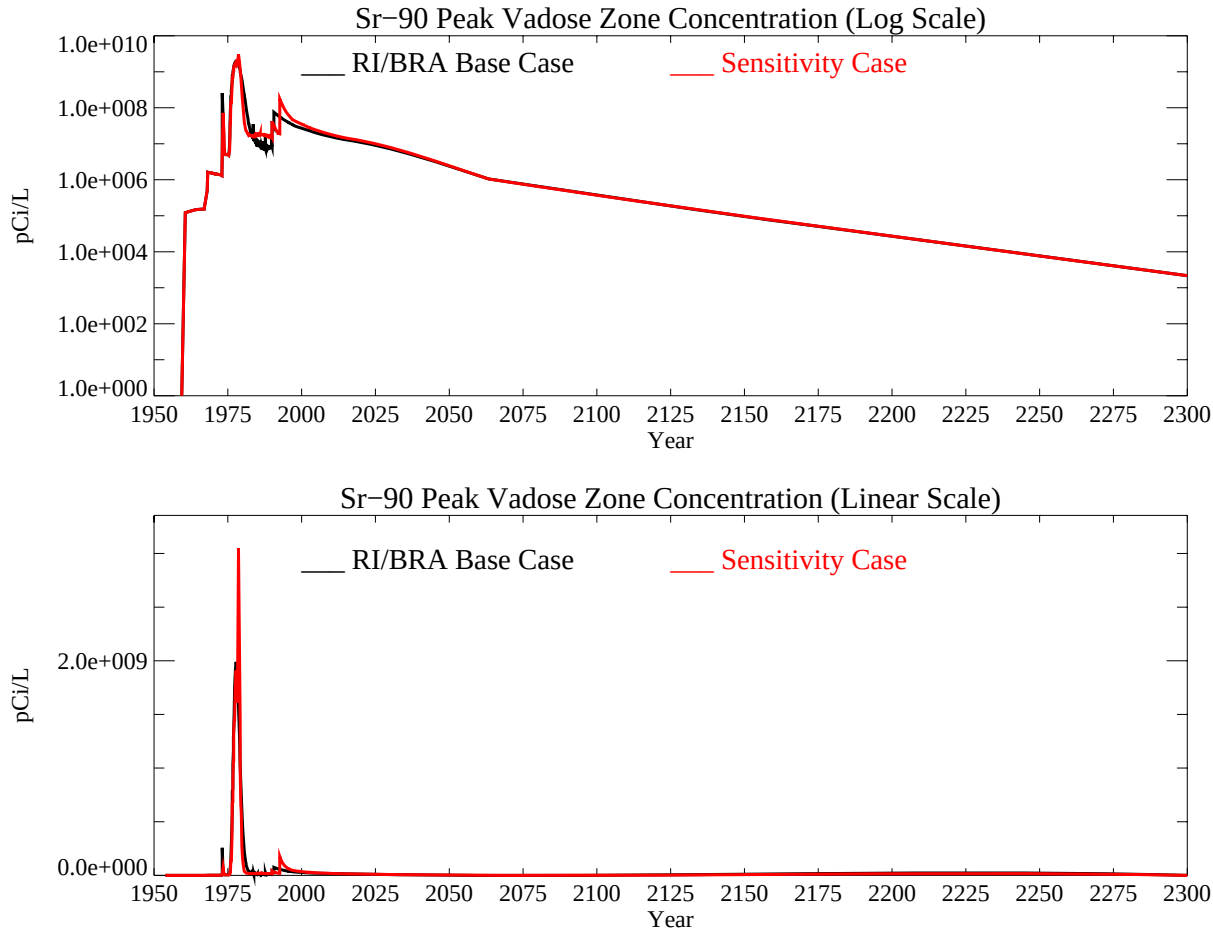

Figure J-11-20. Sr-90 peak vadose zone concentrations with higher 39 cm/yr infiltration through the tank farm. The RI/BRA model is shown in black and this sensitivity run in red.

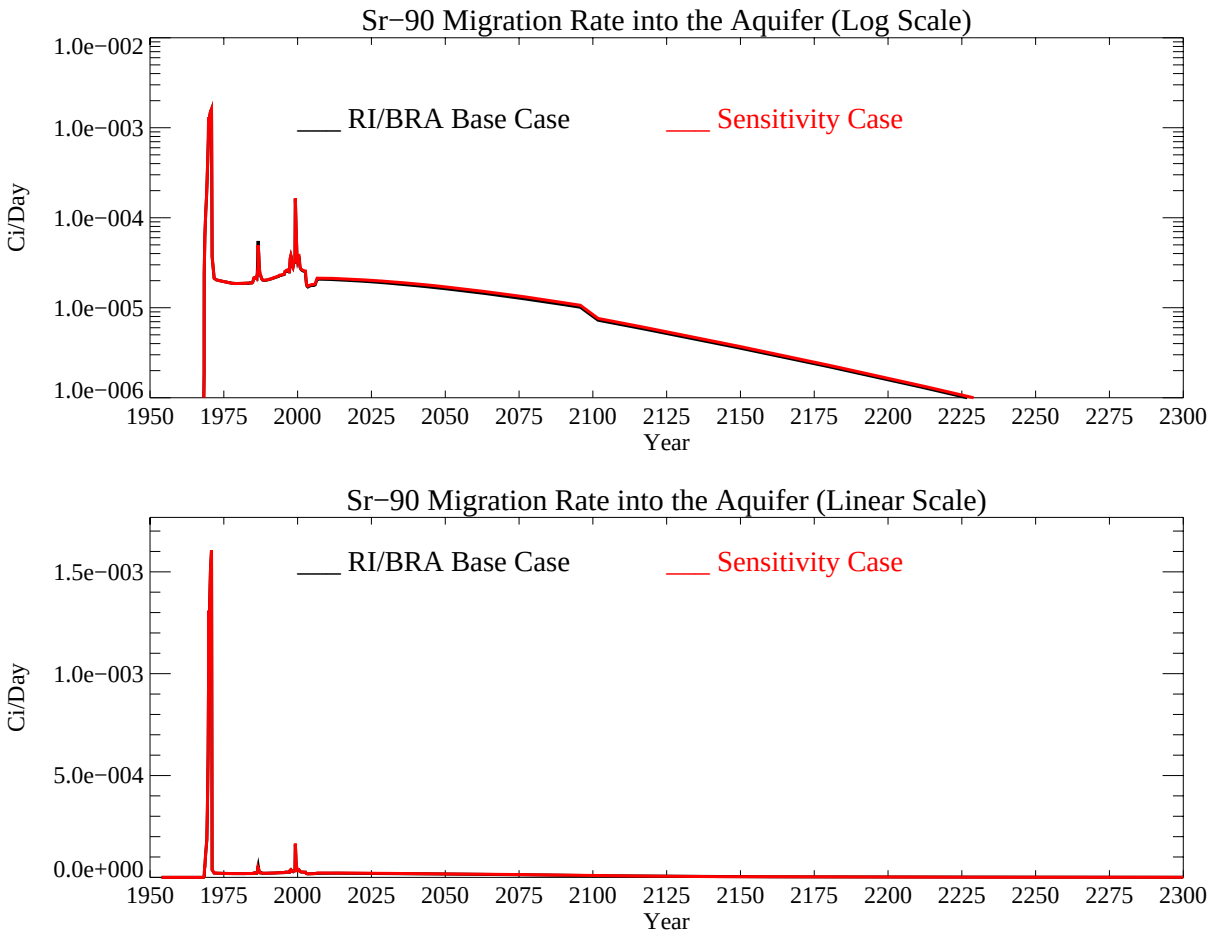

Figure J-11-21. Sr-90 activity flux into the aquifer (Ci/day) with higher 39 cm/yr infiltration through the tank farm. The RI/BRA model is shown in black and this sensitivity run in red.